☹ PROMISES KEPT ☹

Here's a promise you wish we'd break. So do we, but postal rate hikes and drastic increases for paper and other materials required to produce the WSR force our promise to up the subscription rates for the first time in history. It can't be helped, but I think you'll agree we held the line. So here's the deal:

RENEW BEFORE JUNE 30 AT THE OLD RATES!

Effective **July 1, 1995**, the new rates will be etched into stone as follows:

	USA	Canada/ Foreign Surf
Single issue	$ 5.00	$ 5.50
6-mos, 5-issues:	$20.00	$25.00
1-yr; 10-issues:	$35.00	$45.00
2-yr; 20-issues:	$65.00	$75.00

Sorry, Hackers, but we have to do it or dine at the local soup mission. We'll offer current subscribers the chance to lock in the **old rates** for any of the three regular periods of 6-mos, 1-yr, or 2-yrs. Apologies to our Canadian and foreign readers who have to bite more of the bullet. Costs of postage, paper, and extra handling have to be passed on to everyone, pro-rata. When the new rates go into effect, a discount is built in for the longer sub periods.

We remain committed to a program for continual improvement, too. Suggestions are welcome, of course, but barring unforeseen circumstances or better suggestions, we're looking to upgrade our laser printing facility from the present 300-dpi to a 600/1200 dpi workhorse. I'd like to hear from anyone "*in the business*" who might be able to make us a good offer *for the Cause.*

Bill & Cindy

CORRECTION
TO LAST MONTH'S PRICE MENTION ON METEX METERS

AGA Associates informs me that they are negotiating future volume purchases of the Metex M-3850 and other Metex multimeters and that our stated $179.95 price is not necessarily carved into stone. Therefore, if you are interested in a computer-interfaceable data acquisition multimeter, give AGA Associates another call or opportunity to present their latest price and delivery quote:

**AGA Associates
PO Box 99573
Seattle, WA 98199-0573
FAX (206) 217-9138**

AGA Associates is a progressive, forward thinking, new entry into the hacker and hobby scene. You've probably not heard of them before last month, but unless I miss my guess, you'll see more and more of them in the coming months. Their Metex multimeters are hot performers and well worth the hacker's second look. I am still *ga-ga* over their Windows *ScopeView* control program! Wow!

WINDOWS 95
CLOSER TO RELEASE AUGUST-'95

Microsoft's new operating system to replace Windows 3.1 and Windows For WorkGroups 3.11, formerly coded as "Chicago" and now called *Windows 95* seems solidly positioned for a long awaited August, 1995, release.

I have been beta testing *Windows 95* since the Spring of last year, and am happy to report that I think it's just about ready. In fact, Microsoft has already issued a "pre-release" version of *Windows 95* on a first-come, first-served basis for $30. The "pre-release" is designed for corporate and serious users who need to plan ahead and cement their computing needs in advance of purchase.

In case you didn't know, *Windows 95* is an immensely improved graphical user interface (GUI) over previous versions, and just about eliminates the much maligned MS-DOS operating system that reigned supreme since 1980. *Windows 95* comes with a better DOS than ever, but if you are not a DOS lover, it is

possible that you'll never have to deal with a DOS command line and its cryptic commands ever again! If you are a DOS lover, then you may find "*hawg heaven*" with MS-DOS 7.0 that comes with *Windows 95* because you can run "pure" DOS as ever, except with as many simultaneous "windows" of DOS as you like, within limits of reason. Other operating systems such as prior versions of Windows as well as *OS/2* and certain enhancement programs such as *DesqView* have always been able to run multiple instances of DOS but *Win 95* does it the best yet.

I mention *Windows 95* now and will periodically do so because a computer's *operating system* is extremely important to the compleat scannist and hacker. *Win95* offers greatly improved on-and-off-line communications, multitasking, multithreading, stability, and power, and at the same time, is easier to operate than any of its predecessors and competitors.

If you are already into computers and computing, you will want to give some serious consideration to acquiring *Win95* immediately upon release in August. If you know nothing about computers now, but may get one in the next few months, be sure to wrangle a deal for *Win95* on that new computer. Don't get stuck with old MS-DOS and old Windows when the hot new one is about to come down!

Win95 Specifications

Windows 95 is specified by Microsoft to run on 386DX or better computers, with 4-Mb RAM (min). One of my *Win95* machines is a 386SX/16, however, where it runs ok, albeit a little slow, but it always did run slow. The required 4-Mb minimum RAM is exactly that, a hard-core *minimum*, and the more RAM your machine has, the better. Frankly, you'll want to consider 8-Mb as a "productive" minimum from which to extract the maximum performance that *Windows 95* has to offer. If you can afford it, a 486 or better computer is an ideal platform for *Win95*. If you have a 386DX computer, that will be ok, too. My kids each have a 386DX/33 on which *Win95* runs just fine. The single greatest factor that impacts the performance of *Win95*, aside from the type of computer, is RAM. 4-Mb is minimum; 8-Mb best for most, and 16-Mb for heavy duty power users.

What Does Win95 Look Like?

Here, let me show you a screenshot of my desktop as I write this section. The detail isn't great because I had to shrink down the image to conserve space, but you get the idea. Gone are the days of old Windows "program groups" and the complexity of their installation. Everything now runs mostly how you want it to run. Yes, you get to choose!

I prefer to create an icon for most things and to double-click them from the desktop. There are several other ways, one of which will suit most anyone. Down at the lower left corner is a button called START, from which you can do *anything*, simple and easy like.

Win95 and the WSR

Neither space nor topical dedication allows me to pursue the subject of *Windows 95* much farther now. If future interest warrants, I will dedicate a column every other month or so to *Win95* topics simply because computing and radio are welded together. *Win95* is a powerful tool for the compleat scannist and hacker, and I would do a disservice if I ignored it.

Radio is poised on the brink of major change, and most of that change is related to computers. *Windows 95* is the next generation operating system for the downhill run into the 21st century. It's pertinent. It's relevant. Stay tuned. ❽

CONTEST RESULTS

Winners from last month's contest are still flowing in, so I'm not going to announce them or the results until next issue in the offhand chance this issue is mailed before April 30, the contest's deadline. I've also decided to not announce the names of the winners unless they so request because of the volatile nature of the contest. It occurred to me that the target of my little contest might vent some anger or other retribution to the winners and I would never knowingly direct that sort of thing away from me onto anyone else.

Suffice it to say for now that people are more attentive than I thought. The comments from the winners so far have been very heartwarming and interesting. More on this next month.

SPEAKING OF NEXT MONTH

Next issue (V5N5) will be the last for the first half of 1995, and some subscriptions will expire with that issue. You may want to check your mail label for the expiration date and renew early to lock in the old rates and to lighten the load on Cindy who makes sure everything about your account is perfect. You can renew for 6-mos, 1-yr, or 2-yrs, at the *old rates*, through *June 30, 1995*, so give it some thought. and *renew early* to avoid missing an issue or needlessly having to pay the higher rates because you forgot!
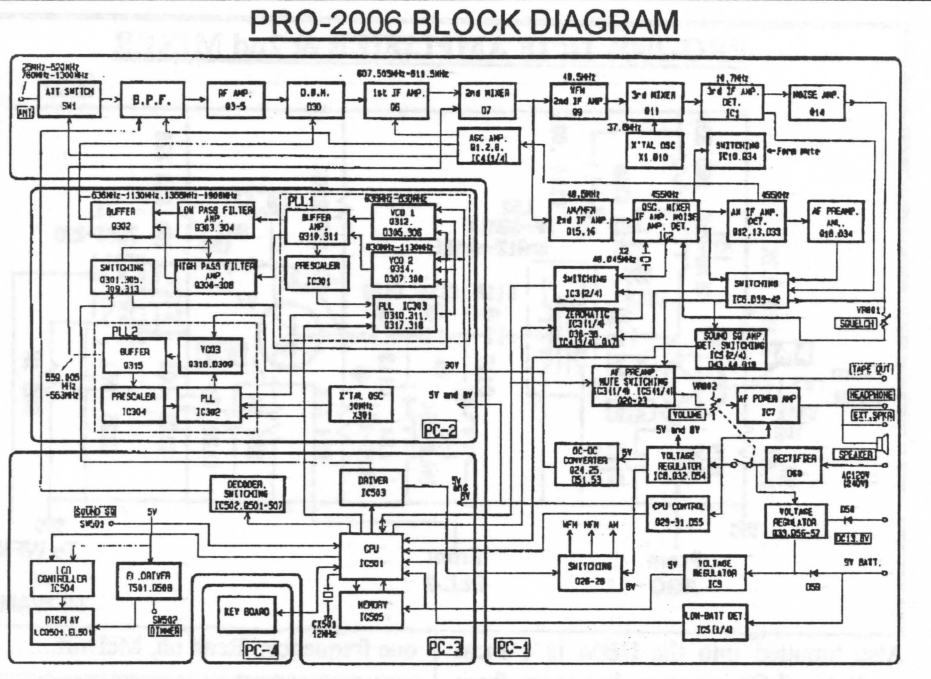
RECEIVER SECTIONS
PRO-2004/5/6 & PRO-2035
~ Explained ~

PRO-2006 BLOCK DIAGRAM

Continuing with our circuit analysis series, this month we will take a look at the main receiver sections of the PRO-2004/5/6 and PRO-2035 series. The PRO-43 will fit this analysis in some ways, too. Schematics and circuit symbols as shown will be for the PRO-2006, but are readily related to the PRO-2004, PRO-2005 and in some instances, the PRO-43 because these receivers share a lot of common circuitry.

RF Front End: Q3-Q5

The most critical section of any receiver is its RF Front End, generally a preamplifier with surge and spike protection and highly desirable bandpass filters. See last month for a detailed analysis of the Bandpass Filter section of these fine radios. We need not repeat it here. But in summary, a signal enters the receiver from the antenna jack and is immediately sensed by DC shunt coil L1 and protection diodes, D1 & D2. Input impedance of the receiver is established by the adjustable L-2.

The RF signal then goes through the ATTenuator switch, S-1, and on into the bandpass filter network as discussed last month.

Out of the bandpass filter network, the RF signal goes into a precision designed, wideband, low noise preamplifier network consisting of transistors, Q3-Q5. Q3 and Q4 are emitter followers, primarily for impedance matching and isolation of Q-5, the main gain amplifier, from the antenna and B.P.F. networks.
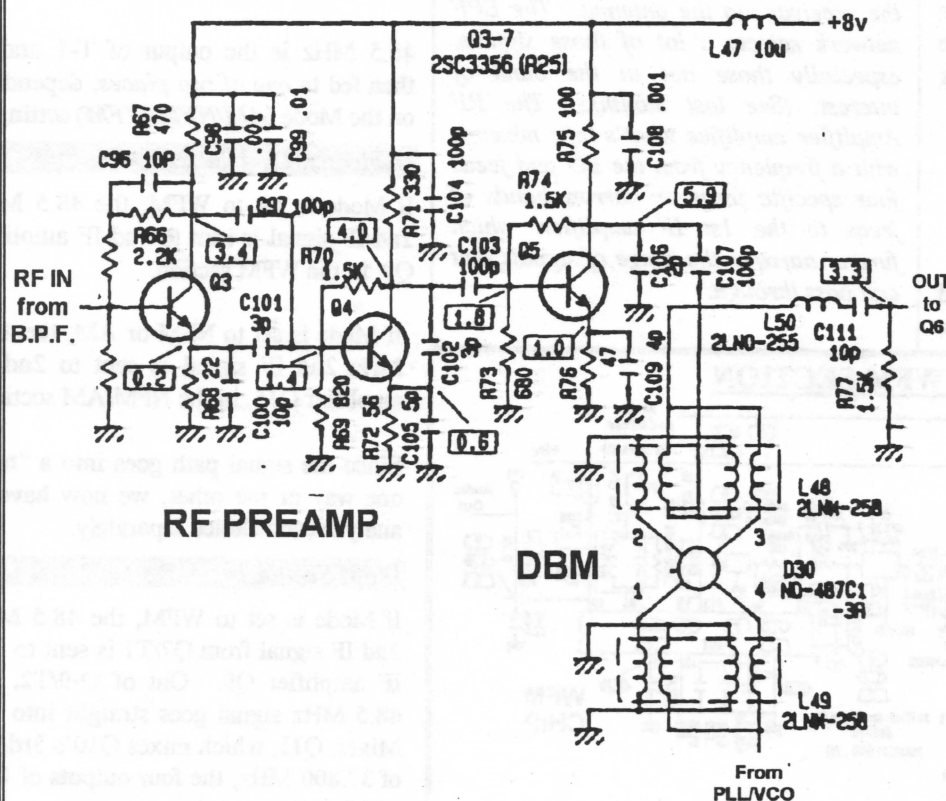
Q3-Q5 are critically designed surface mount transistors and should never be tampered with by any but the most astute hackers....and even then...????

Doubly Balanced Mixer: D30, L48-49

Out of Q5, the highly amplified RF signal goes into a little known circuit that separates the *men from the boys* of VHF-UHF scanners: a **"doubly balanced mixer"**, or D.B.M. A real class-act, the DBM is a superior device or circuit that *naturally* eliminates certain kinds of interference and maintains a purity of its output signal. The purpose of any mixer is to accept two input frequencies and output a single frequency. The outputs of most frequency mixing processes are the sum, the difference, and each of the two input frequencies. Inferior mixers of the type used in most scanners produce plenty of other outputs as well, including phase noise and harmonic modulation products. The DBM is also a great performer under strong signal conditions that tend to overload lesser mixers.
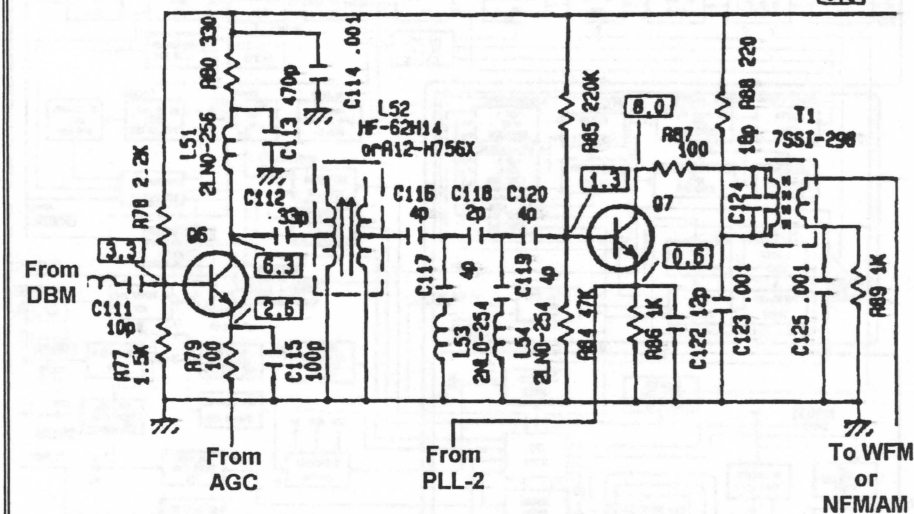
The DBM here consists of a special sealed Schottky hot-carrier diode pack, D30, and is balanced on both its inputs and its output by L49 and L48. None of these three components should ever be tampered by the hacker.

PRO-2006 RF FRONT END AND DBM

RF PREAMP

DBM

PRO-2006 1st IF AMPLIFIER & 2nd MIXER

From DBM / From AGC / From PLL-2 / To WFM or NFM/AM

The highly amplified, narrow range of frequencies (607-612 MHz) that contain the desired signal is fed to the 2nd Mixer, Q7, a typical, single-ended mixer of no special importance other than, like the DBM, it has two inputs and an output. The other input is a second LO frequency from the PLL/VCO section that's selected by the CPU based on the frequency in the display. This injection frequency is a single frequency between 559-563 MHz.

Like all mixers, the output of Q7 consists of four frequencies, sum, difference, and each input frequency. Once again, selectivity comes into play by virtue of tuned device, T-1. Now we get into the nitty gritty of receivers. Consider:

Suppose the output of the 1st IF amp were 611.5 MHz and that the LO was 563.0 MHz. Then the output of Q7 would be four frequencies:

1. Sum of LO and 1st IF freqs: 1174.5 MHz
2. *Difference of LO and 1st IF freqs: 48.5 MHz*
3. LO frequency: 563.0 MHz
4. 1st IF frequency(ies): 611.5 MHz

Now see what happens if T1 is tuned to 48.5 MHz? The other three freqs are so far off that they are totally rejected!

48.5 MHz **is** the output of T-1 and is then fed to *one of two places*, depending on the Mode (*AM/NFM/WFM*) setting.

Choices.....Choices......

If Mode is set to WFM, the 48.5 MHz 2nd IF signal is sent to 2nd IF amplifier Q9, in the WFM section.

If Mode is set to NFM or AM, the 48.5 MHz 2nd IF signal is sent to 2nd IF amplifier Q15, in the NFM/AM section.

Since the signal path goes into a "tee", one way or the other, we now have to analyze each choice separately.

WFM Section

If Mode is set to WFM, the 48.5 MHz 2nd IF signal from Q7/T1 is sent to 2nd IF amplifier Q9. Out of Q-9/T2, the 48.5 MHz signal goes straight into 3rd Mixer, Q11, which mixes Q10's 3rd LO of 37.800 MHz, the four outputs of Q11 which are:

Also inputted into the DBM is a local oscillator (LO) injection frequency from the PLL/VCO section. We'll cover the PLL and VCO at another time, but for now, just know that the DBM gets two inputs, one from the RF Front End, and one from the LO. Obviously, the signal from the RF Front End consists of ALL frequencies between 25-1300 MHz minus those above/below the Bandpass Filter networks that are rejected: still, there is a boatload of signals inputted to the DBM. The LO signal is a tuned signal selected by the CPU based on the frequency that appears in the Display. The range of the LO is 636-1136 MHz and 1368-1908 MHz, depending on the frequency in the Display. The four outputs of the DBM will consist of:

1. Sum of LO and RF freqs
2. Difference of LO and RF freqs
3. LO frequency
4. RF frequency(ies)

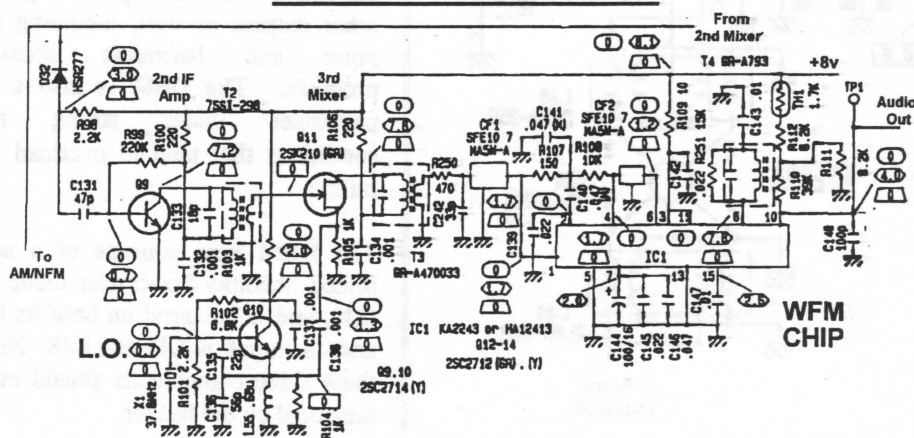Four outputs? That doesn't sound healthy, when you want to listen to just one frequency. Read on, McDuff.......

1st IF Amplifier: Q6

The four distinct outputs of the DBM are fed to narrowband amplifier, Q6, which is tuned by resonant circuit, L52, to *just* the narrow range of 607-612 MHz! This has the effect of rejecting three of the above four signals, leaving ONLY the desired signal(s). Actually, a passband of desired signals, but considerably narrowed from the 25-1300 MHz spectrum present at the antenna!

Sidenote: *Getting the picture here yet? A huge spectrum of signals comes into the receiver via the antenna. The BPF network rejects a lot of those signals, especially those not in the band of interest. (See last month). The RF Amplifier amplifies what's left; mixes it with a frequency from the LO and feeds four specific freqs or narrow bands of freqs to the 1st IF amplifier, which further narrows the range of signals that can pass through.*

PRO-2006 WFM SECTION

2nd IF Amp / 3rd Mixer / From 2nd Mixer / Audio Out / To AM/NFM / L.O. / WFM CHIP

IC1 KA2243 or HA12413

1. Sum of LO and 2nd IF freqs: 86.30 MHz
2. *Difference of LO & 2nd IF freqs:*   *10.70 MHz*
3. LO frequency: 37.80 MHz
4. 2nd IF frequency(ies):   48.50 MHz

Q11 feeds T3, which is tuned to 10.7 MHz, and which thereby rejects the other three undesired signals.

Sidenote: *Regardless of the signals in the antenna, by the time the signal leaves Q11/T3, it is a **fixed** 10.7 MHz and does not change any further until it has been processed by IC-1 into audible signals.*

The Q11/T3 signal goes into a highly selective ceramic filter, CF-1, tuned to 10.7 MHz to further reject noise and undesired signals. CF1 feed the 10.7 MHz 3rd IF signal into IC-1 at Pin 2 where it is internally processed, and outputted at Pin 4 to go through CF2, also tuned to 10.7 MHz, for more rejection of undesired signals, and then back into IC-1 at Pin 6 for final processing into audible signals outputted at Pin 10.

We will discuss what happens to audio signals from Pin 10 in a future analysis of peripheral and control circuits.

NFM and AM Sections

Both: If Mode is set to NFM or AM, the 48.5 MHz 2nd IF signal output of Q7/T1 is sent to a sharply tuned prefilter, XF1, for rejection of undesired signals, and then into 2nd IF amplifier Q15 & Q16.

Q16 feeds T7 for more tuning of 48.5 MHz and rejection of undesired signals and then goes into IC2 at Pin 18.

An internal mixer in IC-2 at pin 18 feeds by a 3rd LO signal from Pin 1 where there is a 48.050 MHz quartz crystal. The output of this 3rd Mixer is:

1. Sum of LO and 2nd IF freqs: 96.55 MHz
2. *Difference of LO and 2nd IF freqs:*   *455 kHz*
3. LO frequency: 48.05 MHz
4. 2nd IF frequency(ies):   48.50 MHz

The 455 kHz 3rd IF is internally processed by IC2 and outputted at Pin 3 to sharply tuned ceramic filter, CF4, for massive rejection of undesired signals.
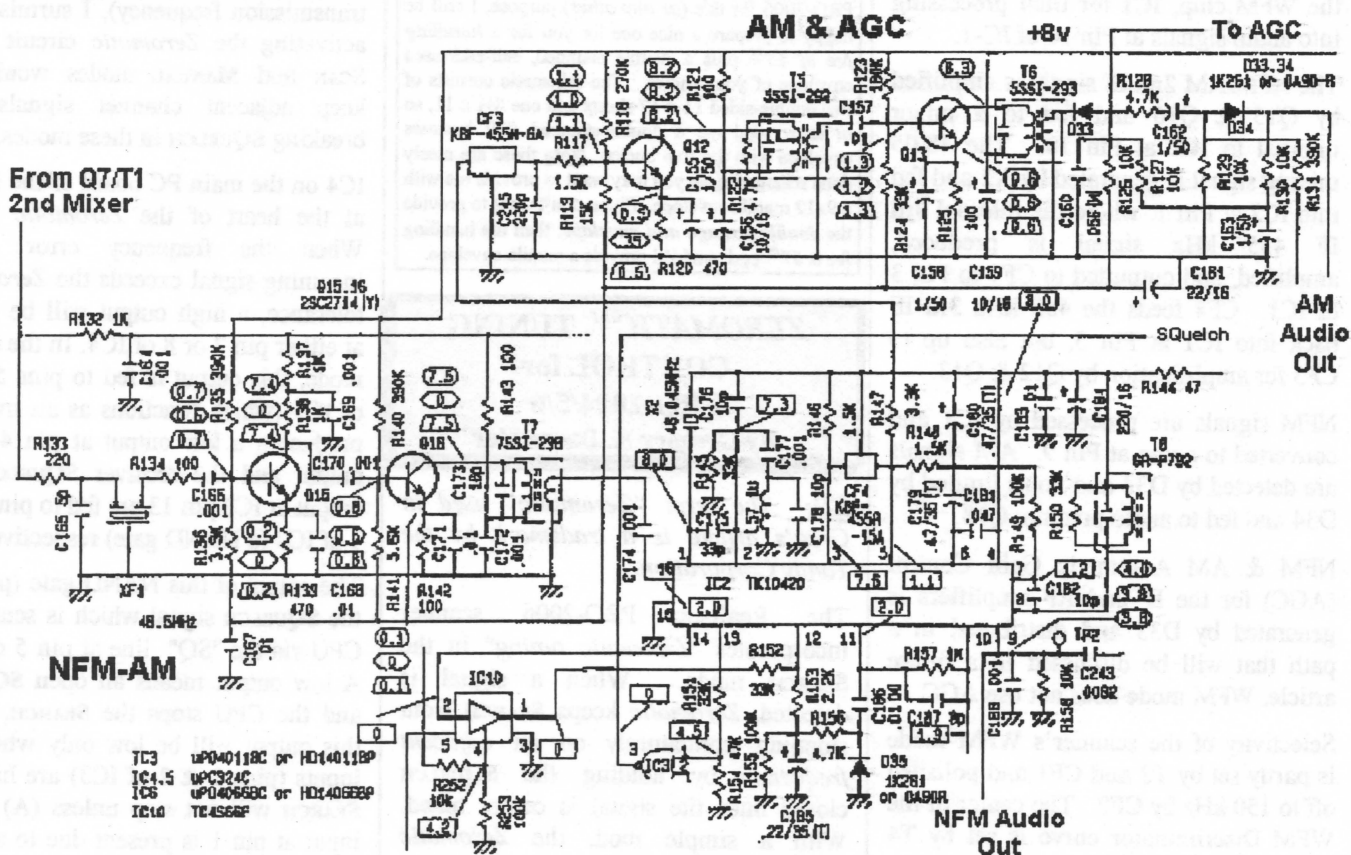
The output of CF4 splits and goes two ways, one back into IC2 at Pin 5 and the other up to ceramic filter CF3, at the input to the AM section. This "tee" path is not a choice like that for WFM and

NFM/AM, though. Even when the receiver is set to the NFM mode, a portion of that 3rd IF signal goes through the AM section of CF3, Q12 and Q13, where an Automatic Gain Control signal is developed by D33 for control of the gain of the RF Front End. We will discuss the AGC and other peripheral receiver circuits at a later date. Just remember for now that the AM section of Q12 and Q13 is used for both AM and NFM modes to generate the AGC signal.

Back to the "tee" at CF4, the other path of which goes back into IC2 at Pin 5 for final processing into audible signals outputted at Pin 9. We will discuss what happens to the audio signals from Pin 9 at a future time.

AM-only: If Mode is set to AM, the 455 kHz 3rd IF signal in IC2 is outputted at Pin3 to and through CF4 for filtering and rejection of undesired signals. The output of CF4 splits (partly discussed previously), one path back into IC2 at Pin 5 and the other path to CF3 at the input to AM section at Q12. CF3 is a highly selective ceramic filter tuned to 455 kHz and which rejects undesired, adjacent signals.

PRO-2006 NFM/AM SECTION

The 455 kHz output of CF3 is amplified by Q12; tuned by T5; amplified again by Q13; tuned again by T6; then fed to AM/AGC detector diode, D33, and filtered into a varying DC (audio!) by C160. The output of D33 splits, one path going on to AGC control circuits (to be discussed later) and the other path through Automatic Noise Limiter diode, D34. The output of D34 is an audio signal. We will discuss what happens to signals from D33 and D34 in a future article on peripheral and control circuits.

Wrap-up and Summary

RF signals from the antenna are prefiltered in the BandPass Filters; amplified by Q3-5; mixed at D30 by a local oscillator signal from PLL1 and converted into the 1st Intermediate Frequency of 607-612-MHz and amplified by Q6. The 1st IF signal is mixed in the 2nd Mixer by a 559-563 MHz LO signal from PLL2 and converted into the 2nd IF frequency of 48.5 MHz and amplified by either Q9 (WFM) or Q15 (NFM/AM), depending on the Mode setting of the receiver.

The WFM 2nd IF signal is mixed in Q11 by a 37.8 MHz signal from Q10, the output of which is 10.7 MHz and fed to the WFM chip, IC1 for final processing into audio signals at Pin 10 of IC-1.

The NFM/AM 2nd IF signal is amplified by Q15 & Q16 and fed to a mixer internal to IC2 at Pin 18. The 48.05 mixing signal is generated by X2 and fed into IC2 at Pin 1. where the internal 3rd IF 455 kHz signal is produced, amplified, and outputted to CF4 to Pin 3 of IC1. CF4 feeds the 455 kHz 3rd IF back into IC1 at Pin 5, but also up to CF3 for amplification by Q12 & Q13.

NFM signals are processed by IC1 and converted to audio at Pin 9. AM signals are detected by D33 and noise limited by D34 and fed to audio preamp, Q18.

NFM & AM Automatic Gain Control (AGC) for the IF and RF amplifiers is generated by D33 and distributed in a path that will be discussed in a future article. WFM mode does not use AGC.

Selectivity of the scanner's WFM mode is partly set by T3 and CF1 and polished off to 150 kHz by CF2. The center of the WFM Discriminator curve is set by T4 with the baseband & audio output at IC1, Pin 10.

Selectivity of the NFM and AM modes is partly set by XF1 and T7. CF4 shapes the 15 kHz selectivity curve for NFM-only signals and partly for AM signals. AM selectivity is set at 6 kHz by CF3. The center of the NFM Discriminator curve is set by T8, with the baseband and audio output at IC2, Pin 9.

Closing Notes

The foregoing analysis is expressly for the PRO-2006, but is matched almost identically by the PRO-2005. The PRO-2035 is a second close match except that some of the circuit symbols differ from that mentioned herein. As an example, the DBM in the PRO-2035 is D31. The PRO-2004 is also the subject of this analysis, but there are a number of design and circuit symbol differences such that it may be difficult for the neophyte to follow this discussion on a PRO-2004 schematic.

For the PRO-2004, PRO-2005 and PRO-2035, it is strongly suggested that you have a schematic of the PRO-2006 to hold up against the one for your scanner so you can follow the discussion, and you will, because these four radios are really very much alike.

IF YOU NEED A SCHEMATIC diagram of the PRO-2006 for this (*or any other*) purpose, I will be happy to prepare a nice one for you for a *handling fee of $5.00* plus a double stamped, self-addressed envelope of your choice. The schematic consists of two double-sided 11 x 17 sheets and one 8½ x 11, so *at least* send me a double-stamped #10 business envelope with the five bucks. **Note** these are nicely done schematics, so you may want to provide me with a 9x12 manila envelope. If you don't want to provide the *double postage and envelope*, then the handling fee is *$7.00* ppd., and I'll provide a manila envelope.

ZEROMATIC[TM] TUNING CONTROL for PRO-2004/5/6
By Gregory K. Doerschler

ED: *The term "Zeromatic" used in Greg's article is a trademark by the Tandy Corporation.*

The Realistic PRO-2006 scanner incorporates "*Zeromatic tuning*" in the SEARCH mode. When a signal is detected, *Zeromatic* keeps SEARCH from stopping prematurely on an *adjacent frequency* by holding the SQUELCH closed until the signal is center tuned. With a simple mod, the *Zeromatic* tuning circuit can be activated in SCAN and MANUAL modes as well. In these

modes, the circuit can SQUELCH splatter from strong adjacent channel signals as well as any images or stray signals that are more than a few kHz off-frequency.

The idea for this mod came as a result of my search for elusive low power signals on 12.5 kHz "split"" channels in the 461-465 MHz band. With the PRO-2006, there is no way to SEARCH these freqs without hitting the standard 25 kHz-spaced business channels as well. (For instance, you can't SEARCH 461.1125 and 461.1375 MHz without also hitting 461.125 MHz.) Activity on the 25 kHz channels was so heavy that I missed most of the elusive stuff on the split freqs.

When I installed the 6400 channel memory mod in my 2006, I decided to program all of the 461-465 MHz split freq allocations in dedicated memory banks so I could SCAN them exclusively, rather than use the SEARCH function. The problem with this plan was that adjacent channel splatter from very strong signals on the standard 25 kHz channels would often lock up the SCAN. Realizing that adjacent channel splatter did not cause problems in the SEARCH mode because of the *Zeromatic* tuning circuit (which holds the SQUELCH closed until the SEARCH stops on the actual transmission frequency), I surmised that activating the *Zeromatic* circuit in the SCAN and MANUAL modes would also keep adjacent channel signals from breaking SQUELCH in these modes.

IC4 on the main PC board of the 2006 is at the heart of the *Zeromatic* circuit. When the frequency error of an incoming signal exceeds the *Zeromatic's* tolerance, a high output will be present at either pin 7 or 8 of IC4. In the SEARCH mode, this output is fed to pins 5 and 6 of IC3 (which functions as an inverter); producing a low output at pin 4. This output and the receiver SQUELCH gate output at IC2 pin 13 are fed to pins 2 and 1 of IC3 (a NAND gate) respectively.

The output of this NAND gate (pin 3) is the SQUELCH signal which is sent to the CPU via the "SQ" line at pin 5 of CN3. A low output means an open SQUELCH, and the CPU stops the SEARCH. Since this output will be low only when both inputs (pins 1 & 2 of IC3) are high, the SEARCH will not stop unless (A) a high input at pin 1 is present due to an open receiver SQUELCH and (B) a high input at

pin 2 is present, which occurs when the incoming signal is tuned within the *Zeromatic* circuit's frequency tolerance.

The frequency tolerance of the *Zeromatic* circuit varies depending upon the SEARCH step. When SEARCHing in 5 kHz steps, +5 volts is supplied by the CPU on the 5kHz line, which runs to the *Zeromatic* circuit via CN3 pin 7. This results in a tighter frequency tolerance when SEARCHing in 5 kHz steps than when SEARCHing in 12.5 or 50 kHz steps. (*This makes sense since your closest step will always be within 2.5 kHz of the actual frequency when SEARCHing in 5 kHz steps, but may be as much as 6.25 kHz off frequency when SEARCHing in 12.5 kHz steps.*) For the remainder of this article, I will refer to these two frequency tolerance settings as the *Zeromatic* "narrow" and "wide" settings.

When the scanner is not in the SEARCH mode, the *Zeromatic* outputs at IC4 pins 7 & 8 are diverted to ground via IC3 pin 10, effectively disabling the *Zeromatic* circuit. IC3 pin 10 is the output of an inverter, which receives its input signal on pins 8 & 9 from the CPU via the "SEARCH" line (CN3 pin 6). The CPU supplies +5 volts on the SEARCH line whenever the scanner is *not* in the SEARCH mode. It is this signal that turns off the *Zeromatic* circuit.

There are several ways the 2006 can be modified to activate the *Zeromatic* circuit in the SCAN and MANUAL modes. The circuit can be used in the wide setting or the narrow setting, or made switchable between the two. A switch which turns the circuit off entirely may also be added for those times when you'd want to be able to hear off-frequency signals (such as when you're trying to identify them).

The wide and narrow *Zeromatic* settings do a comparable job of SQUELCHing adjacent channel transmissions, but the narrow setting does a better job of SQUELCHing images and other interfering signals which are only slightly off freq. For instance, I find that it effectively SQUELCHES many of the cellular telephone images which I receive in the aircraft band when they do not fall directly on the programmed frequency.
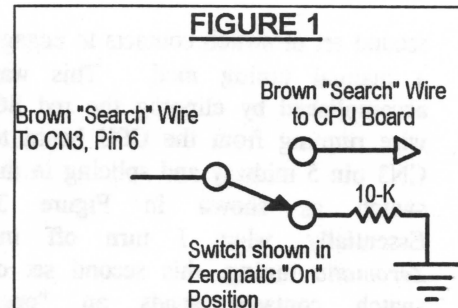
The disadvantage of the narrow setting is that some desired transmissions could also be SQUELCHED if they are a bit off-frequency or if the scanner is not

programmed to the exact transmit frequency. This could especially be a problem for scanners that are subject to temperature extremes (such as in a mobile environment) where the internal oscillators would be more apt to have shifted somewhat over time. Using the narrow *Zeromatic* setting, a signal only 1.5 kHz off frequency would not be heard if the scanner's oscillator had also drifted 1.5 kHz in the opposite direction. The wide *Zeromatic* setting is sufficiently forgiving for this not to be a concern. I use the narrow *Zeromatic* setting exclusively in my 2006 and have not encountered any problems, but it is important to be aware of the potential.
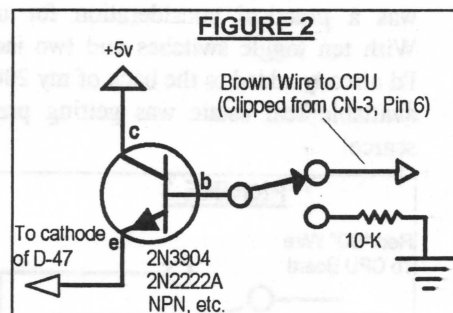
To measure the tolerance of the two *Zeromatic* settings, I swept a strong, unmodulated carrier across the scanner's programmed frequency with *Zeromatic* tuning in the narrow, wide and off settings (using the NFM mode). The carrier broke SQUELCH over a range of approximately ±2.8 kHz with the narrow *Zeromatic* setting, ±5.1 kHz with the wide *Zeromatic* setting, and ±9.0 kHz with the *Zeromatic* tuning turned off. A modulated carrier takes on a "fuzzy," chopped-up sound if centered exactly on the *Zeromatic* tuning's tolerance limit, and disappears altogether quite abruptly when centered just beyond the limit. With the *Zeromatic* tuning turned off, a modulated carrier would produce splatter on voice peaks when centered beyond the ±9.0 kHz limit (as previously discussed).

The easiest form of this mod is to hard-wire the *Zeromatic* tuning circuit to be operational full-time in the wide setting. Clip the brown wire from CN3 Pin 6 on the main board about midway, and connect the CN3 side to ground through a 10K resistor. (CN3 is a 15-pin connector located on the front edge of the main PC board.) If you have the Key Research PS-90 "SEARCH & STORE" mod in your scanner, you will have to remove the white wire connected to IC-3 pin 8 and reconnect it to the clipped brown "SEARCH" wire running to the CPU board.

Figure 1 illustrates how to make this mod switchable using a SPDT switch. Note that the *Zeromatic* function will continue to operate in the SEARCH mode regardless of the position of the switch, and will still revert to the narrow setting when SEARCHing in 5 kHz steps.

FIGURE 1

Brown "Search" Wire To CN3, Pin 6

Brown "Search" Wire to CPU Board

10-K

Switch shown in Zeromatic "On" Position

To activate the narrow *Zeromatic* setting, perform the above wide *Zeromatic* mod (preferably with the switch). Install a NPN switching transistor (2N2222A) as shown in Fig-2. D47 is on the main PC board behind CN3. The cathode is the top lead. If you're good at working in relatively tight places, solder the emitter of the transistor directly to D47 and solder the collector of the transistor to the pad on the PC board directly behind CN3 pin 3; next to D47. This is a source of +5 volts. Other accessible sources of +5 volts include the output (rear-most lead) of voltage regulator IC8 on the left edge of the main PC board, and IC3 pin 14 on the main board.

FIGURE 2

+5v

c

b

Brown Wire to CPU (Clipped from CN-3, Pin 6)

To cathode of D-47
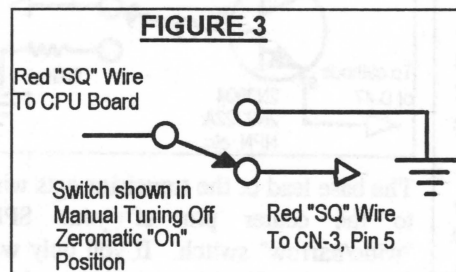
e

2N3904 2N2222A NPN, etc.

10-K

The base lead of the transistor gets wired to the center pin of your SPDT "wide/narrow" switch. If you only want the *Narrow Zeromatic* setting without the ability to switch to *Wide*, omit the switch and 10K resistor and connect the transistor's base directly to the clipped brown SEARCH wire leading to the CPU board. I consider this switch to be a bit frivolous as long as you have the *Zeromatic* on/off switch, but it is your choice if you want to include it. When the scanner is used in the SEARCH mode, the NPN transistor is turned off and the wide/narrow *Zeromatic* selection is determined by SEARCH step. Neither the *Zeromatic* on/off switch nor the wide/narrow switch will affect the SEARCH mode.

I installed a DPDT switch for the *Zeromatic* "on/off" switch in my 2006 instead of a SPDT switch, and used the
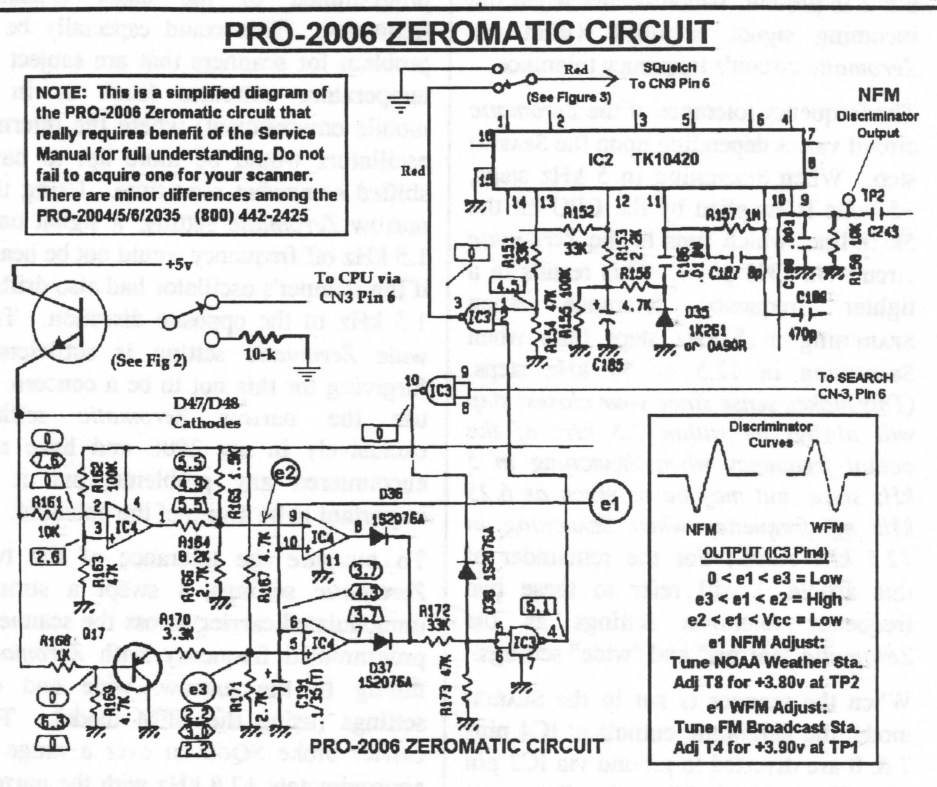
second set of switch contacts to engage a manual tuning mod. This was accomplished by clipping the red SQ wire running from the CPU board to CN3 pin 5 midway and splicing in the switch as shown in Figure 3. Essentially, when I turn off my *Zeromatic* tuning, this second set of switch contacts sends an "open SQUELCH" signal to the CPU; regardless of whether a signal has actually broken the SQUELCH. This prevents the scanner from SEARCHing or scanning since it thinks it's hearing a signal. I can then enter a frequency into any channel, push the DIRECT key, and use the UP/DOWN keys to manually tune up or down from the frequency I entered; similar to a tuning knob. This is the one time when I definitely want *Zeromatic* turned off in order to hear off-freq signals as I approach them.

The manual tuning mod can also be performed or controlled independently of the *Zeromatic* tuning mod. Combining the two on a single switch was a practical consideration for me. With ten toggle switches and two jacks I'd already added to the back of my 2006, available real estate was getting pretty scarce!

To test the *Zeromatic* mod, find a very strong local signal and punch in a frequency 10 kHz away from it (or 5 kHz away, if you're using the narrow *Zeromatic* setting). Open the SQUELCH by turning the SQUELCH control fully counterclockwise. Whenever the strong local signal transmits, the SQUELCH should close; silencing the speaker. With the *Zeromatic* tuning turned off, you should hear splatter from the signal.

You can actually demonstrate this effect without even performing the mod. Enter a frequency 10 kHz away from a strong local signal, on which you can hear splatter when the local signal transmits. Then enter that frequency as both an upper and lower SEARCH limit and go into the SEARCH mode. The SEARCH

PRO-2006 ZEROMATIC CIRCUIT

NOTE: This is a simplified diagram of the PRO-2006 Zeromatic circuit that really requires benefit of the Service Manual for full understanding. Do not fail to acquire one for your scanner. There are minor differences among the PRO-2004/5/6/2035 (800) 442-2425

PRO-2006 ZEROMATIC CIRCUIT

range will be limited to just the one frequency and the *Zeromatic* tuning will be on, so the splatter will not be heard.

I do not believe that there are any negative side-effects to the *Zeromatic* mod. If you encounter an off-freq or adjacent channel signal while scanning with *Zeromatic* engaged, the SCAN may sometimes pause silently for an instant on either the affected channel or the next channel in the SCAN sequence. Without the *Zeromatic* tuning though, the SCAN would stop and you'd be listening to the interfering signal; so it's really not an annoyance by comparison.

Those who have performed the automatic tape recorder switch Mod-33 or the carrier indicator mod from Vol-2 of the Scanner Modification Handbook may notice the relay or LED indicator momentarily click "on" even though audio is not present and the SCAN does not stop. This is due to the fact that these mods take their SQUELCH signal directly from the receiver SQUELCH gate at IC2, and they will sense when an off-frequency signal breaks the SQUELCH even though the *Zeromatic* tuning prevents the open SQUELCH signal from being sent to the CPU.

Understand that *Zeromatic* does not actually improve the selectivity of the scanner. Offending off-freq or adjacent channel signals are "ignored" by the

scanner, but they are still present in the circuit and could mask weaker, desired signals. Nevertheless, my *Zeromatic Mod* allows channels to be scanned that otherwise would probably be locked out because of interference. ❽

ED COMMENT: Greg did a hell of a job on this article; my hat's off to 'im! Wish I had developed it myself. Well, I get to help anyway. Greg didn't have the resources to identify the differences among the PRO-2006, PRO-2005, and PRO-2004, so follows my list of those differences. This Zeromatic Mod will work with these three scanners and maybe others with similar Zeromatic tuning circuits. The PRO-2035 differs enough that an altered procedure will be covered in a future article. A quick exam of the PRO-43 reveals a Zeromatic circuit similar to the PRO-2035's so stay tuned for more. Perhaps Greg and I can work up the mods for other Realistic scanners, too. Sorry, Uniden scanners are much too different for this mod.

PRO-2006	Squelch:	CN-3 Pin 5
	Search:	CN-3 Pin 6
	5 kHz Step:	CN-3 Pin 7
PRO-2005:	Squelch:	CN-3 Pin 5
	Search:	CN-3 Pin 6
	5 kHz Step:	CN-3 Pin 7
PRO-2004:	Squelch:	CN-504 Pin9
	Search:	CN-504 Pin 10
	5 kHz Step:	CN-504 Pin 14

FROM THE READERS

AOR SCANNERS ~ EL PANELS

From: Burleson D. White, Beachwood, OH

Are you planning to review the AOR AR-8000 AR-8000? Is it modifiable? Why not use the CE-232 computer monitor screen to replace the dead PRO-2004/5/6 EL display?

ED: AOR scanner series are marketed by a firm that does not cooperate with or respond to our requests for technical information. Furthermore, AR Service Manuals suck rocks. On that basis, I do not buy AR scanners and therefore never have one in hand to review unless someone gives or loans me one. So far, that hasn't happened.

The CE-232 certainly offers a superior display to that of any scanner, but it is rather expensive for a "replacement". ☺ By the way, the EL panel in these scanners is a backlighting panel; not the actual LCD display module. I have never seen a display fail unless it was physically broken. The EL panel slides behind the Display module.

PRO-2035 HACKS

From: William Shaft, Tinley Park, IL

Doc, Doc: Send me the news. Willie Shaft here has a new PRO-2035 and needs the *Ultimate Scanner* to find out what to do. I have Scanner Mod's Vol 1 & 2 and have hacked the PRO-2004/5/6 and the PRO-34.

The PRO-2004 will always be my favorite because of the nice angle, touch keyboard and metal case. Thanks for the advice warning that the Tandy dorks make parts *not available* for the PRO-2004. Until I see your book, the solder sucker and iron will stay ready. P.S. I love listening to all the **A**dam **H**enry's with car phones. Wireless shouldn't be private.

ED: The PRO-2035 proves hackable, along the lines of the PRO-2004/5/6, since it is much the same scanner, electrically. The Ultimate Scanner offers a good start and the WSR will continue its enhancement and development. I agree that it's downright ignorant of Congress to legislate privacy of the airwaves. That's no different than legislating privacy of conversations in restaurants, workplaces, public parks, and on the sidewalks! Good grief!

A NEW HACKER'S STORY

From: Arthur Zepeda, Visalia, CA Dear Bill, I'm not much for writing letters, but you've got to read my story. I'm going on 28 years of age. I have a high school diploma and also an A.S. Degree in automotive repair. I'm currently going on six years working for the school district in Visalia and about one year as a night lead custodian (janitor, for those who work for the government. HA!). Prior to that, I spent four years in the Army as a Chaparral missile crewman. Aside from Basic and AIT, I was stationed at Ft Ord the whole time.

So where is my electronic experience you might ask? There really isn't any. Aside from the electronic aspect of a car, they just teach you to find and repair.

So, I have a PRO-2006/43/51 and a 22. No, not caliber, an old 6-ch crystal (yard sale $5). A lot of $$$ plus $25 to have someone "install" cellular frequencies. Hmmm. When I purchased the PRO-43 (first scanner), oh, by the way, I just didn't start off with the 43, but that's another story. Anyway, not even in my wildest dreams did I ever think I would open and do the cell mod to the 43! I've never even used a soldering gun on those delicate electronic components! Then.....I saw your two books in a Grove catalog. "I've got to have those," I said to myself.

I was visiting some friends in San Carlos, CA, and we went to a shop called "*Scanners Unlimited.*" Cool shop, by the way. Nothing like it where I'm from (40 miles south of Fresno). I purchased Book 2, and was amazed at how simple you made everything seem.

I started with the C.O.I., Mod 32 on the 2006, and you betcha, I was **proud.** Next came Mods 26 & 27. Big head now! Then came the *WSR*, Book 1 and back issues of the *WSR*. That's when the 43 went on the operating table for the cell mod. This, of course, was my first job dealing with SMT. Wow! My eyes still hurt!

And, just as I'm writing this letter, UPS has just delivered the stuff for the 25,600 channel and mod 28 from JDR Microdevices!!!!

The bottom line is this. Thank you Bill for making it easy for me to add another dimension to my monitoring hobby! I look forward to adding your third book to my library! Try to keep up the good work. I realize it's getting harder to hack because of firmware but you can deal with it. Take care and God bless you and your family! PS I actually paid someone to clip two diodes on the 2006! *Man!*

ED: Thanks for your story. I often wonder how people get started. There were many turning points in my life starting with a transistor radio for my 12th birthday in 1957. I opened the back of the case and poked around on the solder joints with the end of a 100-ft longwire. Suddenly stations roared in, including HCJB in Quito, Ecuador, with an Armed Forces Day program. Hooked! Some years later, I got ripped for a $50 repair bill on a funky old CB radio. That got me started on working on my own stuff. The FCC busted me in 1987 which started me in earnest on scanners. The rest is history. Do keep us posted!

"EMPTY SHELL SYNDROME"

From: Paul Longo, Stamford, CT Your observations in V5N3 of the WSR are, as usual, right on the mark. It seems that form has superseded function in everything. How many restaurants have you gone to in which you find opulent decor, mediocre food and lousy service? Looks like the yuppies put more value on how things (or people) *look* rather than how well they *work*. The "empty shell syndrome" creeping into new scanners is a spin-off of the "empty suit syndrome" that now runs rampant in corporate America. (When are we going to lose these people,?)

ED: We're not, Paul. Look back 500-yrs and see how "backward" people were? Well, 500-yrs from now, they'll be looking back and chuckling at how backward we were. But us Hackers will be their revered ancestors!

NiCd & NMH BATTERY SOURCE

From: Tony Thornton, Mize, MS Bill, do you know of a source for NMH batteries with a better price than the $7.00 each that Metro West wants for them. I've looked in various catalogs such as "Digi Key" and others, but haven't found any listed. I've seen the mfgr's ads in a couple of trade magazines, but found no source but Metro West. I'll pay the $7.00 if I have to but would like to think they're available cheaper than that. Keep up the good work. (Can a NI cad charger be used with them?)......thanks.

ED: A recharger is a recharger, but designs must be optimized, else you'll overcharge or undercharge. I'll do an article on the subject soon, since that's an important topic. You can check the following company, but I have no clue on their prices. Tell 'em we sent ya.

Alexander Battery Co; PO Box 28880, San Diego, CA 92198; (800) 327-0814
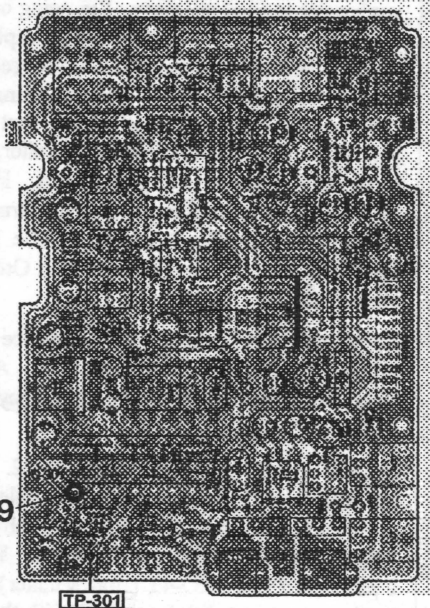
MORE ON CALLER ID

From: Daryll Symington, Holland, OH In the last WSR, there was a discussion on Caller ID. In Ohio, Caller ID will not transmit the number of any phone subscriber that already has an unlisted number. Only "PRIVATE" will show. All callers can block Caller ID by dialing *67 before each call. That way, the caller can choose if he/she wants their number displayed. "PRIVATE" calls don't get answered here. Also, certain social agencies have an automatic Caller ID block on their phones (places like battered women's shelters, etc).

PRO-43 DISCRIMINATOR OUTPUT

Now I have just one question for you. Where is the discriminator point on the PRO-43 radio? I want to run a line from there to a jack, so I can plug in a PL/DPL reader into it, and I need the point where the signal can be picked off before it is stripped in the low pass filter. If you have time, could you post it to me in the Internet at DARYLL1@AOL.COM. Thanks! I'll be waiting for your new book.

PRO-43 AF BOARD (TOP)

ED: How about both ways, here and via the Internet? This way helps others, too. I'll even draw ya a picture so there can be no mistake. The discriminator chip differs little from one scanner to the next, though the chip numbers, pin counts, and styles may very widely. In the PRO-43, it's IC-301, Pin 9, a TK-10427 or TK-10420 surface-mount chip. Pin-9 is also TP-301, one and the same point.

If I were you, I'd solder a 2.2-µF/16v capacitor, (+) lead to Pin 9 or TP-301 and take your output off the (-) lead. That will protect the chip and still pass plenty of signal to your PL device. Remove the rear case of the PRO-43 and you should see Pin 9 staring up at you as shown in the graphic.

Thanks for the added info on Caller I.D. I don't know much about it yet since Calif doesn't allow us to have it. The Ultimate Scanner looks to be available on or about May 1, now so hang loose!

VOTE ON MY NEXT BOOK

Hey guys 'n gals, I need your help for my next book. The *Ultimate Scanner* opens doors for endless opportunity to write, but *what do I write about* next? My publisher and I are considering a series of detailed, moderately priced manuals, each dedicated to *one particular scanner* with a boatload of mods & hacks just for that rig.

Ok, so which do I do first? Second? Third? Why don't YOU dear *WSR* readers vote to give me a sense of direction for the first ones. Then, I'll let the buyers of the series vote on subsequent works. OK, here is what I want you to do: Use whatever is best for you: US mail, fax, e-mail, Compuserve, BBS, or even voice phone....just tell me your first three choices of *make and model* of scanner for me to write about. Please write "*VOTE*" on the outside of envelopes, or on the subject line of e-mail, fax, and BBS messages. List your top three picks in order. There is no deadline, but the sooner, the better, for obvious reasons. I'll compile results and make a tentative decision by July 1 and maybe start work in earnest in August.

My e-mail, CIS-Compuserve, BBS, Fax, and phone info are in the *Reference Information* box at the top of Page 1. Drop me a line with your guidance for my next book. ∞

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